Advanced Solar Mapping Processing Plan

1. Introduction
   The Advanced Solar Mapping Project seeks to produce and evaluate a long-term solar resource data set and use the data set to address the needs of decision support tools, such as the National Renewable Energy Laboratory (NREL) In My Backyard (IMBY) and the National Solar Radiation Data Base (NSRDB). Data processing will occur at the NASA Langley Research Center (LaRC) initially. Once mature, the system will be transitioned to NREL.

2. Scope
   This document will describe the processing system and algorithms developed at the NASA Langley Research Center that will be transitioned to NREL.

3. Project Development Requirements
   The Advanced Solar Mapping Processing System shall be capable of supporting continual production of solar resource data sets and will be designed, tested and implemented per the following specified requirements:
   a. Input Data
      Several data products will be used as required input to the science algorithms. Initially all the input data sets will be collected and processed at the NASA LaRC. Interfaces to these data providers will need to be established at NREL prior transition of the production system. The following table lists the input data required, the source of the data, and the subsytem in which it is used.

Input Data	**Source**	**Subsystem**
MERRA	GMAO http://www.gmao.gsfc.nasa.gov	
ISCCP B1U, Snow/Ice	GISS/NCDC http://www.ncdc.noaa.gov	
TOMS Ozone	GES DISC http://disc.gsfc.nasa.gov	
AeroCom	AeroCom http://aerocom.met.no	
CERES Snow/Ice	NASA LaRC http://eosweb.larc.nasa.gov	

b. System Requirements

The Advanced Solar Mapping processing system will be setup and operated at NASA LaRC. The hardware resources will be located at the ASDC. The Advanced Solar Mapping processing requirements are included in Appendix B. Specifications for the computer resource requirements of the system are included in the following table:

System Component	Requirement	
Machine Type/Environment	x86_64 (IDL)	Powerpc (Fortran)
Operating System	Linux Release2.6.16.60-0.42.8-smp	Linux Release 2.6.16.60-0.21-ppc64
Processors	8	8
Processor Speed	3000 MHz	4005 MHz
Memory	16441368 KB	15792300.000 KB
Swap Space	2104472 KB	8393952.000 KB
Disk/File System Space	SCF3: 90TB	SCF3: 90TB
Network		

c. Software Requirements

The algorithms prepared for operational processing will be run at NASA Langley for a period of time, still to be determined, before being transitioned entirely to NREL for installation and use.

i. Language

All science algorithms are written in IDL and Fortran. Processing and wrapper scripts will be written in Perl.

ii. Tools

GRADS?

iii. Databases

<any databases required?>

iv. Comments

All source files will contain header documentation and be well documented.

v. Source Control

All code will be maintained in a source control system such as Subversion.

d. Data Products

The science products listed address the requirements of the Advanced Solar Mapping project.

i. Format

Output products will be generated in NetCDF and be compatible with NREL tools (NSRDB, Solar Advisor, IMBY and Prospector) and with the GIS systems that are central to the tools.

ii. Spatial Resolution
10KM

iii. Temporal Resolution
3 Hourly (1 hourly?)

iv. Availability/Latency
Data products will be available within *x* hours/days

v. Internal Data Products
The internal products are intermediate data files that pass from one subsystem to another in the data processing system.

Data Product	Size	Format

e. Metadata
Advanced Solar Mapping data products will adhere to Global Climate Observing System (GCOS) guidelines for the generation of climate data records (CDR) and be ISO 19115 compliant. To accommodate data distribution, all metadata files will be created and tagged using Extensible Markup Language (XML) and will include the data set-specific Digital Object Identifier (DOI). Metadata will accurately describe all parameters.

4. Operational Requirements
The Advanced Solar Mapping processing system encompasses *x* components or subsystems. A flow chart illustrating the overall processing system is included in Appendix A.
   a. Subsystems

5. Implementation and Deployment Approach
   a. Establish a processing system design.
   b. Establish input data interfaces.
   c. Begin deployment of the processing system module by module
   d. Compile and run test data sets
   e. Run a specified period of time; benchmark the processing time.
   f. Repeat this procedure until the module is working properly; move to the next module and repeat.

g. Once all modules have been deployed designate a period of NASA LaRC production to verify integrity of the data products.
h. Define & refine science algorithms

6. Transition to NREL
   The Advanced Processing System will be operated and verified at NASA LaRC. The following steps will need to be completed prior to the transition to and subsequent production at NREL.
   a. Establish Input Data Interfaces at NREL
      i. LaRC
      ii. NCDC
      iii. GMAO
      iv. AeroCom
   b. Transition Code to NREL for compilation and running of test data sets
      i. Run the code on both the NASA LaRC and NREL systems for identical periods to verify that the codes are producing the same results. Benchmark the processing times.
      ii. Repeat this procedure for each subsystem/module until that module is working properly; move to the next module and repeat.
   c. Once all modules have been transitioned, designate a period of dual NASA LaRC and NREL production to verify integrity of the data products
   d. Define and refine science algorithms as needed.

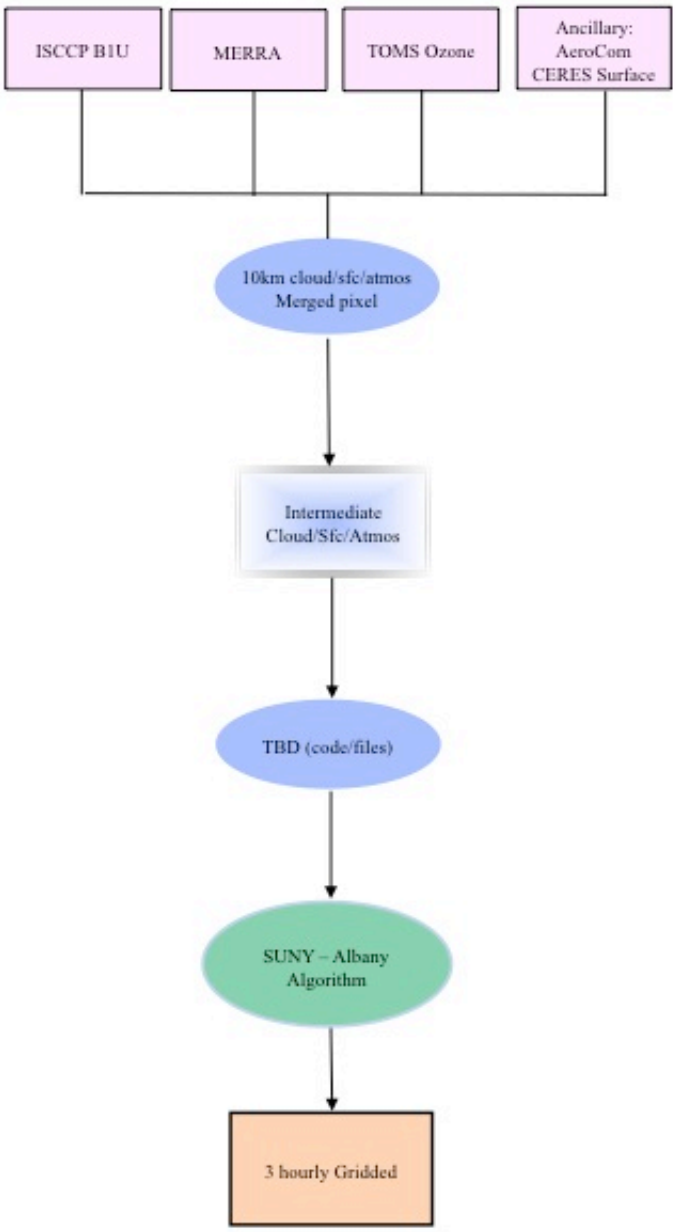
7. Documentation
   Unless otherwise noted, all project documentation will be written using Microsoft Word. The following documentation will be produced as part of the project deliverables.
   a. Design Document – A document that presents the system design details must be produced. This document will be kept under configuration management.
   b. Operator's Manual – An operator's manual must be produced. This manual should be a detailed guide on how to use the system from an operations perspective.

8. System and Software Updates
   a. Once delivered NREL will be responsible for updating the processing system, e.g., changes to algorithms, hardware upgrades (OS), software (Perl)

Acronyms

ASDC	Atmospheric Science Data Center
CDR	Climate Data Record
CERES	Clouds and the Earth's Radiant Energy System
DOI	Digital Object Identifier
GCOS	Global Climate Observation System
GES DISC	Goddard Earth Sciences Data and Information Center
GIS	Geographic Information Systems
GISS	Goddard Institute for Space Studies
GMAO	Global Modeling and Assimilation Office
IDL	Interactive Data Language
ISCCP	International Satellite Cloud Climatology Project
IMBY	In My Backyard
LaRC	Langley Research Center
MERRA	Modern-Era Retrospective Analysis for Research and Applications
NASA	National Aeronautics and Space Administration
NCDC	National Climatic Data Center
NetCDF	Network Common Data Format
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSRDB	National Solar Radiation Data Base
OS	Operating System
TOMS	Total Ozone Mapping Spectrometer
XML	Extensible Markup Language

Appendix A



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NREL IT Requirements for 30 years reprocessing										
Input	**Data Set**	**Monthly Size (GB)**	**Yearly (GB)**	**30 Year (GB)**	**Yearly (GB)**	**30 Year (GB)**	**Yearly (GB)**	**30 Year (GB)**	**Node-hours of processing/ month**	**Total node-hours**
		Current	**Global***		**Land (30%)**		**60N-60S (86%)**			
	ISCCP B1U (5 sats)	2.00	24.00	720.00	N/A	N/A	N/A	N/A	4	1440
	ISCCP Ice/Snow	0.00	0.00	0.07	N/A	N/A	N/A	N/A		
	MERRA 1/2 deg x 2.3 deg	3.31	39.73	1191.80	N/A	N/A	N/A	N/A		
	TOMS Ozone	0.005	0.06	1.80	N/A	N/A	N/A	N/A		
	Aerocom Aerosols (Clim)	N/A	13.22	396.75	N/A	N/A	N/A	N/A		
	CERES Ice/Snow 1/16th Mesh	0.14	1.68	50.40	N/A	N/A	N/A	N/A		
Total	GB	5.46	78.69	2360.81	N/A	N/A	N/A	N/A		
	TB	0.01	0.08	2.31	N/A	N/A	N/A	N/A		
	*Will require									
Output	**Parameter**	**Current**	**Global***		**Land (30%)**		**60N-60S (86%)**			
3-Hourly	Intermediate File	N/A	509.2	15276.0	N/A	N/A	N/A	N/A		
	Lat, Lon (if gridded may not be required)	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	TSI (top-of-atmosphere incoming irradiance) or Clearness index	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Global horizontal flux - Perez	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	DNI-Perez	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Diffuse solar flux - Perez	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Cosine of solar zenith angle (averaged over 3-hourly period)	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Column Water Vapor	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Column Ozone	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Aerosol Optical Depth (0.5 microns)	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Perez Data Quality Flag	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Global horizontal solar flux -SRB	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	DNI-SRB	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Diffuse solar flux - SRB	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Effective Cloud optical depth	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	Effective Aerosol optical depth	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
	SRB Data Quality Flag	N/A	55.48	1664.4	16.644	499.32	47.7128	1431.384		
Total	GB	N/A	1396.88	41906.40	266.30	7989.12	763.40	22902.14	4	1440
	TB	N/A	1.36	40.92	0.26	7.80	0.75	22.37		2.00